WISCONSIN
DEPT. OF NATURAL RESOURCES

A FACT SHEET OF
FREQUENTLY ASKED QUESTIONS ABOUT
TEMPORARY MONITORING WELLS
FOR REMEDIATION AND REDEVELOPMENT
PROGRAM SITES

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Environment
Remediation and Redevelopment Program
Cleanup
Redevelopment
Partnership

Regulations Governing Monitoring Wells

Wisconsin Administrative Code chapter NR 141 specifies standards for design, installation, construction, abandonment, and documentation of groundwater monitoring wells. These standards apply to monitoring well networks for site investigation and for remedial action monitoring at contaminated sites. However, s. NR 141.29 states that "temporary wells may be installed according to less stringent standards than specified for permanent groundwater monitoring wells". This section also requires the Department to approve the construction of temporary wells (TWs) prior to installation and that they be abandoned within 120 days of construction. Temporary wells will vary in their design and the ways in which they do not comply with ch. NR 141. A typical TW has frequently been installed with a casing diameter smaller that the required minimum inside diameter of 1.9 inches and without an annular-space seal. (Note that this fact sheet does not address one-time groundwater sampling using direct-push soil borings.)

The circumstances where temporary wells may be appropriate for groundwater monitoring include:

- Site characteristics that create limitations on the construction of standard wells;
- The performance of a preliminary assessment, rather than a site investigation;
- The need for short-term groundwater monitoring, such as that associated with a rapid site assessment or field screening as part of a thorough site investigation;
- The defining of a potentially sinking plume (e.g., one or more dense non-aqueous contaminants) prior to the long-term monitoring of the plume extent and conconcentration;
- The initial monitoring of changes in the flow path of a groundwater contaminant plume resulting from, for example, seasonal variation or the pumping of a nearby water supply well;
- The need for additional analytical data to supplement or complement an existing data set from standard monitoring wells.

Circumstances where the use of TWs is not usually appropriate are:

- Closure decisions. Data from TWs should only be used to supplement the data acquired from standard monitoring wells. Only when minor contaminant concentrations do not warrant long-term monitoring might data from TWs be the only justification for a case closure request. (See Q&A #14 in this fact sheet.)
- Silt and clay soils. Department staff should be very cautious in considering an approval for a TW in any soil type other than course-grained soils, primarily because of the problem of obtaining a water sample that is representative of the water quality of a silt or clay soil.
- Long-term monitoring. The use of a TW is limited to 120 days after installation by ch. NR 141, Wis. Adm. Code.

Cautions:

Temporary wells, such as those installed with driven-point and direct-push methods, may have a valid role in some site investigations and closures, depending on the site conditions. But caution should be used when interpreting the data generated from wells built to standards less stringent than those of ch. NR 141. Technical difficulties can arise involving construction, development, sampling, and abandonment of temporary wells. The questions and answers of this fact sheet are intended to help the reader to evaluate the appropriateness of TW installations and the reliability of data from these wells. **Note that it is not the intent of this fact sheet to encourage or promote the use of temporary wells.**

USE OF TEMPORARY WELLS
IN REMEDIATION AND REDEVELOPMENT PROGRAM SITE INVESTIGATIONS

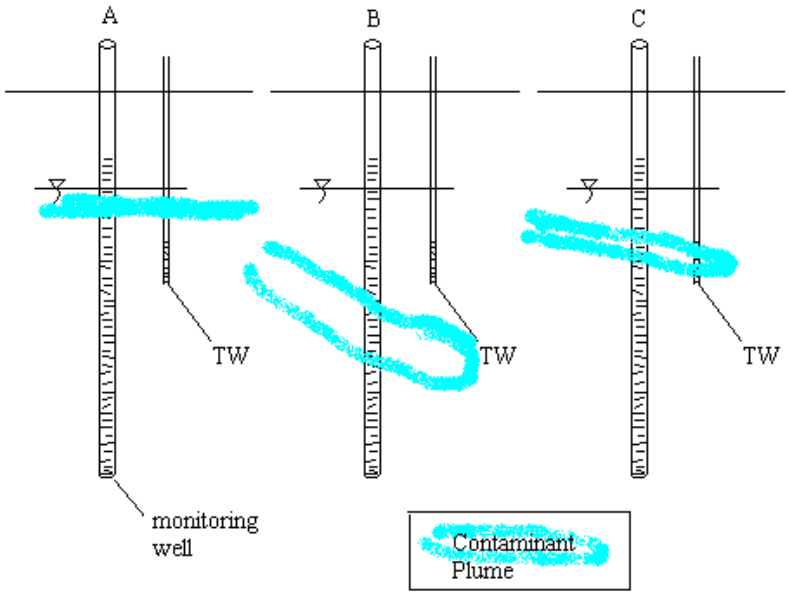
1. **What is the role of temporary wells in defining groundwater contamination in a site investigation (SI) and site clean up for closure?**

TWs may be used to both find a groundwater (GW) contaminant plume and to confirm that the extent of a contaminant plume has been defined, either during an initial investigation or in subsequent investigative phases. To illustrate this point, assume that a down-gradient monitoring well (MW) has contaminant levels at or near the ch. NR 140 enforcement standards (ESs). The well may be at the plume edge, but this conclusion must be confirmed. A TW could be installed 20 feet down-gradient from the MW. If no contaminant detections occur in samples from this TW, the extent of the plume has then been defined with increased confidence. However, if the TW sample has a detected contaminant, the installation of another MW may be necessary, based on the professional judgment of the project consultant and the Department project manager, and on the consideration that a TW can yield concentrations both below and above corresponding data from standard monitoring wells.

Generally, the nearer the contaminant concentration in a TW is to the ES, the more likely a MW and follow-up monitoring may be justified. If the TW data include one or more ES exceedances, a MW and follow-up sampling is probably necessary before site closure can be obtained. The same logic holds true when defining the vertical extent of a plume.

Cases have been reported in which GW samples from TWs and direct-push soil borings have no contaminant detections while groundwater from a monitoring well in the same area is contaminated. The diagrams on the following page illustrate several possible explanations for this observation. TWs installed with direct push methods are not effective at consistently monitoring at the water table because of the short screens used with these wells. Figure A illustrates the short screen set below a shallow plume. Figure B shows the short temporary screen above a diving plume. Figure C shows the case where the short screen of the TW intercepts the plume and would produce a sample with a higher contaminant concentration than would a permanent monitoring well where contaminant dilution across a longer screen would occur. This scenario assumes that borehole soil smear and lack of well development do not interfere in the analytical results.

The absence of a contaminant in a TW does not necessarily rule out contamination because of quality control considerations such as lack of well development or adequacy of sampling techniques. While the same may be true for any monitoring well that complies with ch. NR 141, it is far more likely that the TW installed by direct push methods will not yield data that is representative of actual groundwater conditions. If a TW has one or more ES exceedances, a MW should generally be installed and follow-up sampling performed as part of a thorough site investigation.



Figures A, B, C. Illustrations of reasons that water quality results from permanent and temporary wells can differ.

TWs are of limited use in defining plume status by the 120-day limit on their use. A TW should not be installed outside of the area into which the plume margin is expected to advance in 120 days, based on groundwater flow system and contaminant transport information known about the site.

2. **Can temporary wells be used for obtaining water table elevations and aquifer characteristics like hydraulic conductivity?**

TWs are more appropriate for measuring hydraulic head and are less appropriate for collecting GW quality data. (The TW screen must intersect the water table to be used to measure the water table elevation.) They are not appropriate for collecting hydraulic conductivity, transmissivity, etc., because TWs cannot be properly constructed or developed and therefore will produce erroneous data when performing slug and similar tests. In addition, the radius of influence would be too small to be meaningful. Even if a well is installed with a filter pack and was developed, it may still not yield representative results.

Note that the usefulness and validity of TWs for obtaining hydraulic head measurements depends on the geologic environment. In environments of high hydraulic conductivity, TWs may function appropriately, but in environments of lower conductivity, the use of TWs becomes dubious. Groundwater in TWs in environments of lower hydraulic conductivities may only reach hydraulic equilibrium with its surroundings after a long period of time, if ever. Surrounding conditions may never be accurately represented. If the use of a TW is appropriate, a period of stabilization after installation should be observed before any head measurements are performed at the TWs.

3. **Can TWs be used as piezometers?**

Yes, they can be used as piezometers for collecting hydraulic head measurements and may actually be more accurate than a piezometer that complies with ch. NR 141. The classic definition of a piezometer is a pipe open at the top and bottom (no screen) that measures hydraulic head at a discrete point in the aquifer. A TW typically has a much shorter open interval than most permanent piezometers. Consequently, water level measurements and analytical data from TWs may not be comparable to data from a well with a longer screened interval. Note, however, that deeper TWs mean more difficulty with installation of the well and an effective annular seal, and also with abandonment of the well.

4. **Are TWs for measurement of both field and lab parameters?**

TWs are more appropriate for the measurement of non-sensitive field parameter measurements, such as chloride, nitrate, specific conductance, and alkalinity. Concentrations of these parameters are not as influenced by subsurface conditions or differences in sampling protocols as are those of, for example, volatile organic compounds. However, measurements of these field parameters have more validity in geologic environments with higher hydraulic conductivities. When TWs are used to evaluate other types of contaminants, the results may not be representative of groundwater conditions. In addition, parameter results may only represent conditions at the well screen in a stratified subsurface environment because of the short screens commonly used with TWs.

TEMPORARY WELL CONSTRUCTION AND ABANDONMENT

5. **Can TWs act as a conduit for downward migration of contaminants if they have no annular space seals?**

Yes, but with the proper equipment, an annular seal can accompany the installation of a TW by direct-push methods. However, the small diameter boreholes do run a higher risk for failure of the seal, even under the best of installation conditions. Since the wells are being placed in a potentially contaminated environment, the boring or well can possibly act as a contaminant conduit. Dual-wall direct-push equipment has a temporary outer casing that reduces this possibility and makes placement of some grout for an annular seal more feasible.

6. **Do DNR requirements contain any minimum construction specifications for temporary wells?**

Although there are no specifications for temporary wells in the Wisconsin Administrative Code, ss. NR 141.27 and NR 141.29 contain a description of constraints that should be considered when installing them. The TW installation method and design, including such details as casing size, filter packs, and annular-space seals, may impose limits on the usefulness and environmental safety of the technology.

7. **Temporary wells may have no security from vandalism and no protection from damage. Can these disadvantages be addressed?**

The installation of protective casing with a lockable cap can be used to prevent vandalism and protect against damage. Security problems are reduced by using TWs in compliance with s. NR 141.29, which limits the use of a TW to 120 days after installation.

8. **Should temporary wells be developed, and can it be done adequately, given that they lack a filter pack?**

Development requires the movement of water in and out of the borehole to remove fine-grained soil particles that become smeared on the sides of the borehole during installation. Removal of these particles increases the hydraulic connection between the surrounding material and the well screen. Consequently, groundwater samples collected from a TW that has been developed may be more representative of groundwater quality in the vicinity of the well, compared to an undeveloped well. Development of TWs may be difficult because of the small well diameter that limits the development procedure and the small amount of water in the well available for development. These are significant disadvantages and are the reasons why sample analytical results from these wells may not be representative of groundwater quality, except those from a geologic environment of high hydraulic conductivities.

Another TW development mechanism is jetting the well screen with water under pressure. However, this method has several significant limitations: an administrative code variance must be obtained for the introduction of water into the well; and, a representative sample can be obtained from a jetted well only after groundwater has completely replaced the introduced jetting water in the well. This process will take place slowly in environments of lower hydraulic conductivity.

9. **Are there any special considerations in abandoning temporary wells?**

Several physical constraints should be considered when abandoning a TW. Where the annular seal is narrow in width or is nonexistent, collapse of the borehole upon removal of the casing is likely. This will make it difficult to get sealing material to the bottom of the hole. Another constraint is that standard 3/8" bentonite chips are too large to easily fall down the typical 1"or 1¼" well casing and granular bentonite can easily "bridge" in the small diameter casing. The use of a grout will solve this problem. A small diameter well casing can serve as the grout tremie pipe, a conduit for pumping grout into the well from the bottom up to the top. In a low hydraulic conductivity environment, the water in the well is not easily displaced by the grout and should be pumped out first. As an alternative, the well screen can be broken and the casing removed as the grout is pumped. This provides space and a path for the grout to displace the water. Grout specifications for well abandonment can be found in s. NR 812.26 and s. NR 141.25(2), Wis. Adm. Code.

The issue of TW abandonment should be considered before the TW is installed. Temporary wells are often installed in places where access is limited. This can make getting the proper well abandonment equipment to the well difficult.

Well abandonment forms available from the Department must be completed and submitted to the DNR for each well abandoned, as required by s. NR 141.25, Wis. Adm. Code.

VALIDITY OF GROUNDWATER QUALITY RESULTS

10. **Are groundwater quality results from temporary wells reproducible and verifiable? Are the results representative of the surrounding groundwater?**

Research and case studies have produced inconclusive answers to these questions. For example, Kaback et al., (1990) compared the ability of a Hydropunch and 4 adjacent MWs to produce valid groundwater sample data. Results for 2 of the MWs showed excellent correlation with the Hydropunch analytical data. However, results for the other 2 wells showed variation. The reproducibility of results is dependent on the development of the TW and the hydraulic connection between it and the GW

system, the hydraulic conductivity of the surrounding geologic environment, and on the sampling protocol. (See the *Groundwater Sampling Desk Reference, 1996.)*

11. **Without a filter pack, temporary wells may yield turbid samples, implying the need for filtering. Is this consistent with current procedures? Is low-flow pumping a viable alternative?**

Filtering is only allowed for metals analyses. Low-flow purging techniques should yield a less turbid and more representative sample compared to purging with a bailer, for example. But, low flow pumping may be difficult in many TW situations, because of constraints such as small diameter well casing (i.e. the pump is too large) or the well is too deep (a peristaltic pump will not function properly). Note also that suction pumping techniques can result in a low bias in volatile organic compound analytical data.

12. **Can representative groundwater samples be obtained from the bottom of a soil boring installed by the direct-push method?**

Typically, no. The quality of GW samples collected from soil borings may be more compromised than those collected from TWs. This is because of possible turbidity of the sample and the reduced hydraulic connection between the point of sampling in the borehole and the surrounding subsurface environment. Both conditions are attributable to the lack of a well screen filter pack.

Note that ch. NR 141, Wis. Adm. Code, is not intended to regulate the sampling of groundwater using direct-push soil borings.

REGULATORY ISSUES

13. **Have any of the methods for installing TWs already been approved?**

The Department has not approved any methods of installing TWs, relying instead on the exception-approval process described in s. NR 141.29 and s. NR 141.31. See #14 below for a discussion on the procedure for approving the use of TWs and on the use of data from unapproved sampling points.

14. **Explain the approval procedure for the use of temporary wells, including who grants the approval and the expected and required level of detail for submitted requests.**

Typically, approval of deviations from the following administrative code requirements for TW installation **is required** (see s. NR 141.29 and s. NR 141.31):

- s. NR 141.07 (casing)
- s. NR 141.19 (borehole diameter)
- s. NR 141.21 (well development)
- s. NR 141.25 (well abandonment)

A TW approval request is submitted, usually by the site owner's consultant, to the DNR project manager or regional hydrogeologist. The TW approval request should include:

A statement of the reason for the TW approval (cost reduction alone is unlikely to be a valid justification);

A description of the geologic environment in which the TWs will be installed;

Reference to the administrative code sections that contain monitoring well construction specifications that would not be met by the approved TW;

Information on the proposed deviations from the code-required specifications (for example, casing, screen, sand-pack, grout).

The approval process does not require the payment of a fee.

Approvals by Department staff may be issued either verbally or in written format prior to the installation of a TW. Verbal approvals should be documented in the site file by a written summary of the approval, including the site name, the date, the contact name and affiliation, and the information submitted as part of the request.

A second approval approach is to issue a consulting company a written approval for the company's standard TW installation and specifications. The consultant would then inform the Department project manager when a TW was installed according to the pre-approved TW specifications. Deviations from the pre-approved specifications would have to be approved either verbally or in writing prior to installation. Department staff should require that the approved installation specifications include the limitation of installations to appropriate geologic environments (for example, those with higher hydraulic conductivities). In addition, a pre-approval should be issued by a DNR project manager and be limited to the project manager's assigned sites. Note that use of consultant design pre-approvals for TWs is not recommended, primarily because pre-approval will eliminate the opportunity for a DNR project manager to evaluate specific site conditions that may necessitate a modification of the consultant's pre-approved TW design.

DNR staff who approve the installation and use of TWs should be aware that the approved TWs will be considered approved alternative monitoring wells constructed in compliance with NR 141, and, consequently, can be used to obtain data to justify closure of a site. (NR 726.05(3)(a)3. contains the requirement that "samples shall be taken from monitoring wells constructed in accordance with ch. NR 141". However, that section also provides that "The department may approve an alternative monitoring program designed to show whether groundwater quality standards have been met.") Therefore, staff should be prepared to consider TW data in site closure requests if Department approval has been given for the TWs. However, staff should use their professional judgement to evaluate the likely validity of groundwater quality results from the approved TWs, based on knowledge of site-specific conditions, in the same way that staff currently evaluate the quality of data from standard monitoring wells. Note that Department staff do not have to consider or accept, in the closure review process, data from temporary wells that have not been approved.

15. **Temporary wells must be abandoned after 120 days as required by NR 141. Is this time period adequate to gather groundwater data and also to prevent these wells from being forgotten?**

Yes, in most cases. The administrative code has two timelines for abandonment. Section NR 141.29 allows the use of a TW for 120 days after installation, and s. NR 141.25(1)(b) requires the abandonment of all monitoring wells within 60 days after use has been discontinued. The time period that expires first defines when the TW must be abandoned. If contamination is evident and verified and must be further defined, then the installation of a permanent monitoring well is warranted.

TEMPORARY WELL LIMITATIONS

16. **What are the potential benefits and limitations of temporary wells?**

Benefits: Overall cost savings; lower time and materials costs; less soil cuttings; minimized number of MWs needed and subsequent long-term sampling; optimized placement of MWs; better definition of discrete zones of contamination (properly placed short well screen); a quicker, more detailed site characterization if TWs are used in combination with cone penetrometer testing (CPT); better identification of the areal extent of contamination that may be missed by conventional MWs (for

example, identification of MTBE and other less-retarded contaminants that can migrate faster than the main plume).

Limitations: direct-push technologies (geoprobes, CPT, etc.) may be limited by soil type and depth, and soil and rock "refusal"; smaller sample volumes are collected; TWs generally are difficult to develop; turbid samples; uncertain quality of analytical results; potentially unrepresentative water quality samples, particularly in soil of lower transmissivity; short screen length may miss contamination; difficulty in filter-pack and annular-space seal installation; TWs may be incapable of collecting a GW sample near the water table; long sample collection time and increased sample alteration (oxidation and volatilization) in silt and clay formations.

17. **Are temporary wells better suited to some types of soils (in terms of grain-size and extent of heterogeneity) than others?**

Yes; they are much better suited to geologic environments with greater homogeneity and courser grain size with associated higher hydraulic conductivities.

18. **Given their limitations, how can temporary wells be used to facilitate rapid site assessment?**

See Q&A #1 in this document and refer to the *Groundwater Sampling Desk Reference*, pp. 2 – 6.

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REFERENCES

Kabeck, D.S., C.L. Bergen, C.A. Carlson, and C.P. Carlson. 1990. Testing a Groundwater Sampling Tool: Are the Samples Representative? Ground Water Management 2: 403-417 (4th National Outdoor Action Conference)

Karklins, Steve. *Groundwater Sampling Desk Reference*. Wisconsin Department of Natural Resources PUBL-DG-037 96, September 1996

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